

[0038] **FIG. 4B**—depicts an energized embodiment of the invention implemented on an article of apparel.

[0039] **FIG. 4C**—depicts an exemplary de-energized embodiment of the invention implemented on an advertising type signage.

[0040] **FIG. 4D**—depicts an exemplary energized embodiment of the invention implemented on advertising signage.

[0041] **FIG. 5A**—depicts an embodiment of the invention where a plurality of independently controllable regions is provided.

[0042] **FIG. 5B**—depicts an embodiment of the invention where a plurality of graphical images are affixed to each independently controllable region.

[0043] **FIG. 5C**—depicts an embodiment of the invention where one of the plurality of graphical images is energized.

[0044] **FIG. 5D**—depicts an embodiment of the invention where two of the plurality of graphical images is energized.

[0045] **FIG. 6**—depicts an embodiment of the invention where an embodiment of the invention includes multiple electrodes.

[0046] **FIG. 7**—depicts a process flow chart of various exemplary embodiments of the invention.

DETAILED DESCRIPTION

[0047] The invention provides in various embodiments a low-cost and low-power dynamic graphical imagery display device and method of physically manipulating graphical images by electronically deforming a compliant surface upon which the graphical images are affixed. The dynamic graphical imagery display device may be used in advertising, company logos, in printed media and on articles of apparel. The use of dynamic graphical imagery is advantageous as it is well known in the relevant art that human visual perception is more sensitive to moving images than those that are static. The appearance of motion unconsciously draws a person's attention to an apparently moving object and away from that of apparent static object. This is the common foundation for slight of hand tricks and magical illusions.

[0048] In one embodiment of the invention, the graphical image manipulated under electronic control is a logo that is affixed to product packaging or a product itself.

[0049] In another embodiment the graphical image manipulated under electronic control is a logo displayed upon an article of apparel such as a hat, a shirt, or athletic shoes. In another embodiment of the invention, the graphical image manipulated under electronic control is a drawn character such as a cartoon character printed in a book, greeting card, or other printed medium. In another embodiment of the invention, the graphical image manipulated under electronic control is a personified facial depiction such as a drawn or photographed face image.

[0050] In another embodiment the graphical image manipulated under electronic control is an advertisement displayed within a magazine, upon posted sign, or upon a posted billboard.

[0051] **FIG. 1** depicts a perspective view of an embodiment of the invention where a graphical image **10** is affixed to an upper electrode **20A'** of a dynamic graphical imagery display device. The graphical image **10** and the lower electrode **20B'** are shown in dotted lines to better illustrate the relative thickness **22** of the electroactive polymeric material **15**. Application of a sufficient voltage to the connection leads **20A**, **20B** coupled to the upper and lower electrodes **20A'**, **20B'** causes the electrodes to compress the electroactive polymeric material **15** due to attractive forces, resulting in the deformation of the thickness **22** of the electroactive polymeric material **15** sandwiched between the electrodes **20A'**, **20B'**. For simplicity and ease of understanding, the electrodes **20A'**, **20B'** are referred to hereinafter using their associated leads **20A**, **20B**. One skilled in the art will appreciate that the electrodes **20A'**, **20B'** and connection leads **20A**, **20B** are closely related but may have different dimensions and be constructed from different conductive materials.

[0052] Referring to **FIG. 1A**, a generalized block diagram of a dynamic graphical imagery display device is depicted. The dynamic graphical display device **5** includes a graphical image **10** affixed to one of its exposed surfaces **15**. A graphical image **10** is affixed to the exposed surface of the dynamic graphical display device **5** to at least cover a portion of the region of one of the electrode surfaces. The electrodes **20A**, **20B** are extremely thin, so that graphical image distortion is not usually a consideration.

[0053] However, in situations where the electrode thickness is problematic, a thin layer of compliant material such as latex or similar elastomeric material may be used to provide a gentle transition in surface contours. The electrodes **20A**, **20B** generate the electrical attractive force when a sufficient electromotive force is received from an electromotive force (EMF) generator **25** coupled thereto.

[0054] The EMF generator **25** provides an output voltage that is generally in the range of about 100-500 volts, depending on the specific requirements of the particular electroactive device selected. The graphical image **10** may be applied to an area that only covers at least a portion of the electrode **20A** or may cover a portion of the electrode **20A** and a portion of the electroactive polymer **15** extending beyond the electrodes **20A**, **20B**. In either case, the electrodes **20A**, **20B** should be covered by an insulating material during usage to prevent the possibility of an accidental shock.

[0055] The EMF generator **25** may include one or more internal batteries in which the voltage output is increased by a voltage increasing circuit to the 100-500 voltage range. One of the main advantages of electroactive polymer devices is the low current requirements which allows for the use of small electrical power sources (e.g., batteries) to provide the necessary electromotive force.

[0056] In general, the EMF generator **25** is a DC to DC converter. In an alternate embodiment of the invention, a DC to AC inverter may be utilized in applications where a varying rate of change is desired in the graphical image **10** affixed to the dynamic graphical display device **5**. To be visually perceivable, the AC output frequency should be maintained below 60 Hz. An optional modulator **30** may be coupled to the EMF generator **25** to superimpose AC signals onto a continuously supplied DC voltage.